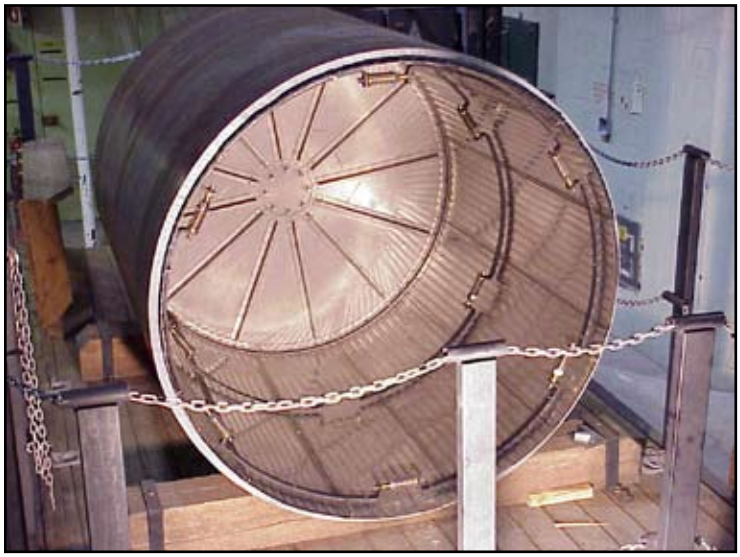
Development and Full-Scale Demonstration of Multiport Dryer Technology for the Forest Products Industry

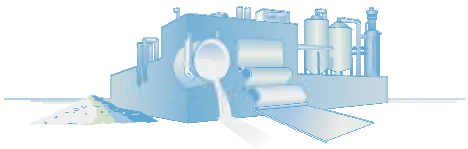
Breakthrough Dryer Technology Will Greatly Improve Papermaking Efficiency

The concept of steam drying is nearly two centuries old, yet the use of steam dryers for paper drying has changed little over the years. Conventional steam drying technology uses heat from steam introduced into large-diameter rotating steam drums to dry paper as it passes over the drum's outside surface. A major thermal resistance to heat transfer, when using this technology, is the condensate rim that forms on the inside surface of the drum. To minimize the inefficiency of heat transfer, siphoning systems are used to continually remove the condensate layer. However, productivity improvement is limited with only incremental improvement in current dryer technology. The industry needs a major breakthrough that can double or triple the current drying rate.

A new multiport dryer design concept offers a radically different approach to increasing paper drying rates. The multiport system uses smaller-sized ports (or longitudinally-oriented flow passages) located in close proximity to the inside surface of the cylinder dryer. This design substantially improves heat transfer by significantly minimizing the condensate layer thickness and increasing the surface temperature of the dryer shell. In addition, the smaller-sized port design increases the velocity of steam flow, further improving thermal efficiency.



The multiport dryer insert was fabricated and assembled in a shortened dryer. The final assembly of the multiport dryer insert in the shortened (~2 m) dryer is shown in the photograph. The inside diameter of the shortened dryer is 1.46 m (4.8 ft). The flow port plates are shown in position with two spring rings used to hold the plates to the inside drum surface. The insert head is visible at the far end of the drum.



Benefits for Our Industry and Our Nation

The use of multiport dryers can potentially increase paper production rates by up to 50 percent, significantly improving capital effectiveness and financial performance of the papermaking industry. Successful commercialization of the multiport dryer technology industry-wide could result in annual energy savings of 17 trillion Btu (British thermal units) and a decrease in CO_2 emissions of approximately 1.6 million tons per year by 2030.

Applications in Our Nation's Industry

Multiport dryer technology will find use across the entire papermaking industry. Existing cylinder dryers may be modified to include the multiport concept with inserts that can be retrofitted at one-fifth the cost of a new dryer. For new plants, multiport dryer technology will make new cylinder dryers more economical due to its smaller-sized ports and thinner shells.

Project Partners

Argonne National Laboratory
Argonne, IL

University of Illinois at Chicago
Chicago, IL

Kadant Johnson Inc.
Three Rivers, MI

International Paper
Loveland, OH

Project Description

The goal of this project is to develop a breakthrough multiport dryer technology for retrofit applications that could be easily and quickly implemented while keeping capital costs to a minimum. With the feasibility of the multiport dryer concept already proven in Argonne National Laboratory's unique Multiport Dryer Heat Transfer Test Facility, full-scale tests leading the technology to commercialization will be demonstrated next.

Barriers

- By-pass steam flow at specific joint types within the multiport dryer insert
- Reduce field installation time to accommodate current planned downtimes in operating plants (i.e., less than one day)

Pathways/Milestones

The objectives of this project will be achieved through (1) improving the multiport dryer insert design based on scale-model tests; (2) constructing a full-length multiport dryer insert; (3) pilot-testing the full-scale dryer and comparing test results to baseline tests of conventional dryers; and (4) assessing the technical and economic feasibility of the technology for retrofit application.

Commercialization

After successful full-scale demonstration and field testing of the multiport dryer technology, redesign work of the insert will be conducted for manufacturing. The multiport dryer technology will then be ready for transfer to industry through implementation in existing mills. Because most existing paper machines are dryer-limited, there is a strong market potential for this new technology. Project industrial partners, Kadant Johnson and International Paper, will provide fast channels for the technology's transfer in the United States.

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A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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